IDENTIFICATION AND EVOLUTION OF A DUST-SAND STORM ABOVE NORTH AFRICA FROM METEOROLOGICAL SATELLITE PICTURES

V. B. Lipatov

Translation of "Obnaruzheniye i evolutsiya pyle-peschanoy buri nad severnom Afriki po snimkam s meteorologicheskikh sputnikov Zemli," Meteorologiya i gidrologiya, No. 4, April 1974, pp. 78-80

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16. Abstract

From television images received at the Leningrad State University station from the ITOS and ESSA meterological satellites, a dust-sand storm above North Africa was successfully recorded and its evolution was followed. The synoptic situation causing formation of the dust-sand storm and the dust flow at high altitudes over the Mediterranean Sea following the storm are discussed in the article. Use of the images to estimate the rate of transport of dust, size of the dust cloud and its lifetime, as well as to analyze the synoptic situation more accurately and to more accurately establish the position of the cold front on the surface and the wind speed and direction at high altitudes also is mentioned.

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ANNOTATION

From television images received at the Leningrad State University station from the ITOS and ESSA meteorological satellites, the evolution of a dust-sand storm over North Africa was successfully recorded and followed. The synoptic situation causing the formation of the dust-sand storm and the dust flow at high altitudes over the Mediterranean Sea following it are discussed in the article.

IDENTIFICATION AND EVOLUTION OF A DUST-SAND STORM ABOVE NORTH AFRICA FROM METEOROLOGICAL SATELLITE PICTURES

V. B. Lipatov

Television images obtained from Soviet meteorological satellites /78* of the Meteor system, as well as from the American meteorological satellites of the ITOS series, make it possible, not only to identify dust-sand storms and flows and to study their structures [1, 4], but to follow their evolution.

From images obtained from the American ITOS-1 and ESSA-8 satellites by the Leningrad State University station, the formation and development of a dust-sand storm above the African Coast and subsequent transport of the dust over the Mediterranean Sea were successfully tracked. A dust-sand storm, the center of which was 300 km east of Tripoli, was recorded on a television image of the North African coast from the ITOS-1 satellite (Fig. 1). A spot, not as bright in tone as the cloud mass, with diffuse boundaries, the storm region, and a dust cloud "tongue" elongated above the water surface, also with diffuse boundaries and gradually disappearing in the direction from the shore to a distance of 180 km, were highly visible in this region.

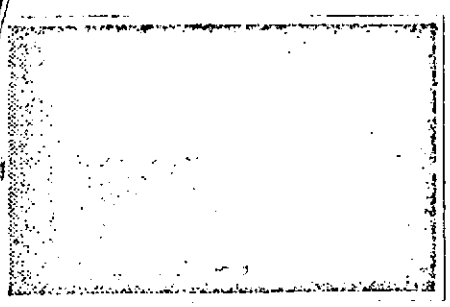

Fig. 1. Fragment of television image of dust-sand storm above North Africa from ITOS-1 satellite, obtained 16 July 1970 at 15 hours Moscow time.

In the Tripoli region, thick cumulus and cumulonimbus cloud cover, extending perpendicular to the shore line above the Jebel Nefus Mountain Range, is seen, in the form of a bright band with broken and diffuse edges. The cloud cover extends over the Mediterranean Sea, in the form of two bands (Ci clouds), less

* Numbers in the margin indicate pagination in the foreign text.

bright in tone, also with diffuse boundaries, to a distance of 300 km from the shore.

Analysis of the synoptic situation showed that, on 15 July, south of the Atlas Mountains, in the region of the Great Eastern Erg, on a diffuse cold front connected with a low pressure area located above western Europe, a low pressure area had formed (center at a point with coordinates 32° north latitude and 8° east longitude), which had filled by 15 hours on the 16 July, and its center had moved to the south- /79
east, to a point with coordinates 30° north latitude and 14° east longitude. The synoptic situation on 16 July, at 15 hours Moscow time, is represented in Fig. 2.

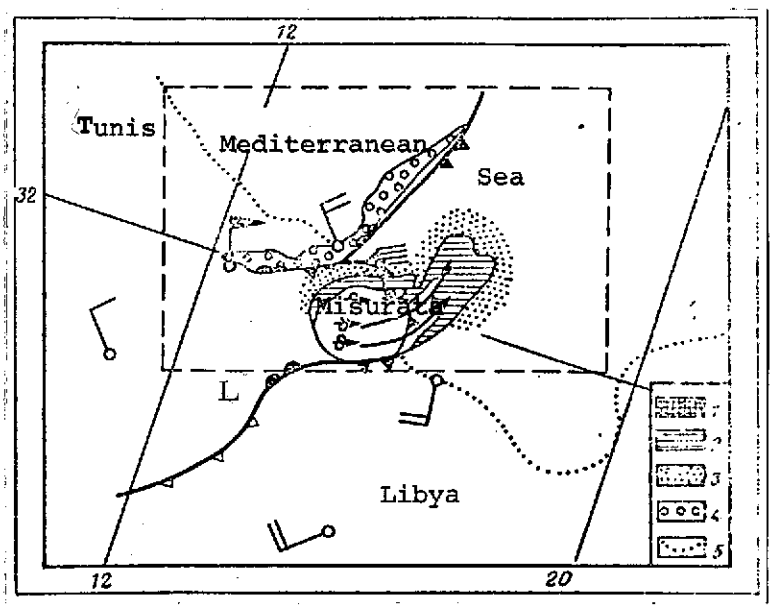

Fig. 2. Interpretation diagram: 1. severe dust cloudiness (visibility less than 4 km); 2. medium dust cloudiness (visibility 4-10 km); 3. moderate dust cloudiness (visibility 10-20 km); 4. cloudiness; 5. shoreline.

On the northeast periphery of the low pressure area, ahead the main part of the cumulonimbus cloud cover, located over the Jebel Nefus range, connected with an occluded front, at the meeting place of the colder northwest flow and the dry, hot southern one, a dust-sand storm arose.

The southerly flow took up a mass of dust, raised from the earth by the strong vertical streams in the region of the front (storm wall). The sharper southern boundary of the storm center, curved along the southern boundary of the front, is highly visible on the photo. The dust-sand storm which developed extended over the surface of the Mediterranean Sea.

The Misurata meteorological station recorded the presence of dust raised in the air with a horizontal visibility of 3 km. at 15 hours on 16 July.

On a television image obtained almost a day later (Fig. 3), the dust cloud is seen in the form of a band with diffuse boundaries, up to 80 km wide, which was considerably less bright than the cloud cover, extending from Cyrenaica to Greece. Thus, the dust moved with the southerly flow at a speed of 36 km/hour. At 15 hours on 17 July, the dust also was noted on a television image, and it had moved 100 km to the east in this case.

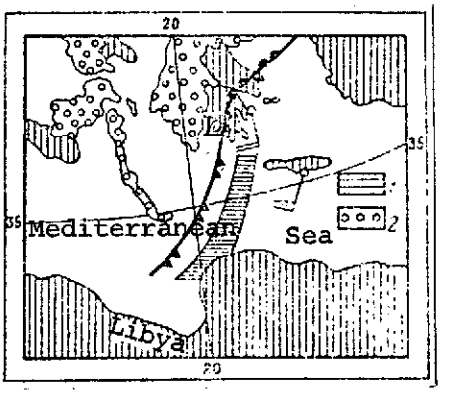

Fig. 3. Interpretation diagram of dust flow above Mediterranean Sea, according to television image from ESSA-8 satellite, obtained 17 July 1970 at 11 hours Moscow time: 1. dust cloud; 2. cloud cover.

At 15 hours on 17 July, a haze with a horizontal visibility of 8 km was recorded in southern Greece. The synoptic situation at 15 hours on 17 July was the following. The low pressure center which was south of Tripoli and had moved to the east, was filled, but a trough extending from the central regions of Europe through the Balkans to North Africa remained, and a persistent southerly flow remained with it ahead of the cold front, with which the dust cloud was connected and which was necessary for its existence. This flow was maintained to an altitude of 5 km, according to the barometric topography maps.

In this manner, with the aid of television images received from meteorological satellites, not only can a storm be identified, but also,

as a result of sequential tracking of the dust clouds by the television images, the development of a dust-sand storm can be studied. /80

From the images of the high-altitude dust cloud arising as a result of the dust-sand storm, the routes of transport of dust can be tracked and regions of its possible deposition can be projected. In particular, our data show that dust storms and flows in the atmosphere undergo daily fluctuations, with maximum development at 14-15 hours and, besides, they develop and evolve together with mesoscale meteorological structures. In the process of evolution, the dust structures pass through a number of stages, from the vortex at the surface to formation of a dust flow at high altitudes. Television pictures from satellites make it possible to estimate the speed of transport of dust, the dimensions of a dust flow and the period of its existence (for a period of a day, in this case). At the same time, observation of a dust storm and its evolution by television images makes it possible to more accurately analyze the synoptic situation in regions with sparse meteorological coverage (deserts and ocean regions). From the sharp boundary of a dust storm along the line of the front (storm wall), the position of a cold front at the surface can be precisely defined and, from the boundary of high-altitude dust flows, the position of a front and the wind speed and direction at high altitudes can be decided.

REFERENCES

1. Vinogradov, B.V., Grigor'yev, A.A., Lipatov, V.B., "Structures of dust storms from television image data from ITOS-1 satellite," Doklady AN SSSR, 1972.

2. Makhon'ko, K.P., "Study of transport of atmospheric dust," Izvestiya AN SSSR, seriya geofizika (11) (1960).

3. Nalivkin, O.V., Uragany, buri i smerchi [Hurricanes, Storms and Sandstorms], Nauka Press, 1969.

4. Fett, W., Der atmospharishche Staub [Atmospheric Dust], VEB Deutsch Verlag der Wissenschaft, Berlin, 1958.

5. Prospero, I.M., Bonatti, E., Schubert, C., Carlson, T.N., "Dust in the Caribbean atmosphere traced to an African dust storm," Earth and Planet. Sci. Letters 9 (3) (1970).